

CLAIMS

What Is Claimed Is:

1. A composition for producing a self-cleaning coating on a surface, the
5 composition comprising:

an aqueous mixture comprising (i) water, (ii) nanoparticles having a particle
size of less than 300 nanometers and (iii) a surface modifier selected from the
group consisting of water-soluble hydrophobic surface modifiers and water-
dispersable hydrophobic surface modifiers capable of forming a continuous film
10 from an aqueous solution,

wherein a self-cleaning coating is formed on a surface after the mixture is
applied to the surface and the water evaporates.

2. The composition of claim 1 wherein:

15 the surface modifier is water-soluble hydrophobic surface modifier.

3. The composition of claim 1 wherein:

the surface modifier is selected from the group consisting of cationic
polydimethylsiloxanes having at least one nitrogen-containing end group.
20

4. The composition of claim 1 wherein:

the surface modifier is selected from the group consisting of alkoxysilanes
having the formula $R_aSi(OR^1)_{4-a}$ where a is 1 or 2, R is C_{1-10} alkyl, and R^1 is C_{1-10}
substituted or unsubstituted alkyl.
25

5. The composition of claim 1 wherein:

the surface modifier is selected from the group consisting of
polydimethylsiloxanes crosslinked with an alkoxysilane having the formula
 $R_aSi(OR^2)_{4-a}$ where a is 1 or 2, R is C_{1-10} alkyl, and R^2 is C_{1-10} alkyl.
30

6. The composition of claim 1 wherein:

the surface modifier is selected from the group consisting of
fluorourethanes with polyalkylene oxide units.

7. The composition of claim 1 wherein:
the surface modifier is selected from the group consisting of fluorinated acrylic polymers and copolymers.

5 8. The composition of claim 1 wherein:
the surface modifier is selected from the group consisting of perfluoroalkyl methacrylic copolymers.

10 9. The composition of claim 1 wherein:
the surface modifier is selected from the group consisting of fluorinated acrylic copolymers.

15 10. The composition of claim 1 wherein:
the water-soluble hydrophobic surface modifier is selected from the group consisting of fluorosurfactants.

11. The composition of claim 1 wherein:
the nanoparticles have a particle size of less than 200 nanometers.

20 12. The composition of claim 1 wherein:
the nanoparticles have a particle size of less than 100 nanometers.

25 13. The composition of claim 1 wherein:
the nanoparticles are selected from the group consisting of metallic oxides.

30 14. The composition of claim 1 wherein:
the nanoparticles are selected from the group consisting of silicon dioxide, aluminum oxide, zirconium oxide, titanium dioxide, cerium oxide, zinc oxide, and mixtures thereof.

15. The composition of claim 1 wherein:
the nanoparticles are selected from the group consisting of solid fluoropolymers.

16. The composition of claim 1 wherein:
the aqueous mixture has a pH of 7-11.

5 17. The composition of claim 1 wherein:
the aqueous mixture is a colloidal dispersion.

18. The composition of claim 17 wherein:
the aqueous mixture further comprises a dispersing agent.

10 19. The composition of claim 18 wherein:
the dispersing agent is present in the aqueous mixture at 0.5 to 10 weight
percent based on the weight of nanoparticles in the aqueous mixture.

15 20. The composition of claim 18 wherein:
the aqueous mixture has a pH of 4-11.

20 21. The composition of claim 20 wherein:
the dispersing agent is selected from the group consisting of phosphated
polyesters, acidic polyesters, polyfunctional polymers with anionic/non-ionic
character, copolymers with pigment affinic groups, and mixtures thereof.

25 22. The composition of claim 1 wherein:
the surface modifier can produce an unstructured surface having a surface
energy below 30 dynes per centimeter.

23. The composition of claim 1 wherein:
the surface modifier can produce an unstructured surface having a surface
energy below 20 dynes per centimeter.

30 24. The composition of claim 1 wherein:
the aqueous mixture is essentially free of organic solvents other than
coalescing solvents.

25. The composition of claim 1 wherein:

the surface modifier is water-soluble hydrophobic surface modifier, and
the aqueous mixture comprises 0.001-10 weight percent based on the total
weight of the mixture of the water-soluble hydrophobic surface modifier.

- 5 26. The composition of claim 25 wherein:
 the water-soluble hydrophobic surface modifier is selected from the group
 consisting of fluorinated acrylic polymers and copolymers.
- 10 27. The composition of claim 1 wherein:
 the aqueous mixture comprises 0.001-10 weight percent based on the total
 weight of the mixture of the nanoparticles.
- 15 28. The composition of claim 27 wherein:
 the aqueous mixture further comprises a dispersing agent present in the
 aqueous mixture at 0.5 to 10 weight percent based on the weight of nanoparticles
 in the aqueous mixture.

29. A process for producing a self-cleaning coating on a surface, the process comprising:

5 applying the composition of claim 1 to a surface,
 allowing the water to evaporate thereby forming the self-cleaning coating on the surface.

30. The process of claim 29 wherein:

10 the self-cleaning coating includes surface protrusions such that the coating has a surface roughness of 100 nanometers or less, the surface roughness being defined as a number which equals the mean deviation of the surface protrusions from a hypothetical perfect flat surface.

31. The process of claim 29 wherein:

15 the self-cleaning coating includes surface protrusions, the maximum protrusion being 200 nanometers high.

32. The process of claim 29 wherein:

20 the self-cleaning coating is transparent.

33. The process of claim 29 wherein:

 the surface is a shower wall or a toilet bowl.

34. The process of claim 29 wherein:

25 the surface is a window.

35. The process of claim 29 wherein:

 the surface is a fabric.

30 36. The process of claim 29 wherein:

 the coated surface is stain resistant.